

論文の内容の要旨

論文題目 A Comparative Study on Modularity of Transnational Building Construction Method

(モデュラリティ評価による建築構法の国際比較に関する研究)

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Globalization has been widely infiltrating into our life from any aspects, and even the building construction industry couldn't keep itself away from this trend. Since 1970s, numerous construction companies had been eager to expand global wide by chasing after the immense infrastructure investment in those Middle Eastern oil-producing countries. Meanwhile, Japanese construction industry was also dedicating to the international market share by starting with building overseas factories or branch office for Japanese enterprises to participate this game. Unfortunately, the overseas revenue never constantly contributes to the growth of company. Moreover, litigation, procrastination, budget overrun became daily routine in this field.

Although a large quantity of resource has been deployed into this field, little is known about what kind of organization consciousness fundamentally shapes the difference of construction methodology among countries which would jeopardize the success of transnational project. Numerous attempts have been made to create a systematic understanding how those different countries would work together seamlessly. As to that, adversarial behavior was one of the most important subjects to this attempt. However, the behavior mechanism is still a missing piece of this puzzle.

Most of researches and practice have been noticing that the culture difference is one of the major factors leading to the failure of transnational building construction. This research is trying to establish a mechanism model to demonstrate how the adversarial tendency of differential culture difference would affect the relationship between modularity and interface, and how it leads to the outcome of transnational building project consequently. Furthermore, this research would attempt to find an interdependence model to locate the possible risk area, and improve the advanced planning process accordingly.

A typical building construction is basically dealing with two major elements, the material behavior and the human behavior. Taking both material and human behavior into building construction projects as analysis subjects is difficult to operate within one model due to the natural property of these two element are very different. Fortunately, in the book of "Design Rules, Vol. 1: The Power of Modularity" by Prof. Carliss Y. Baldwin and Prof. Kim B. Clark, the concept of task has been introduced to public to solve this issue. Both material behavior and human behavior can be investigated at the same level as a task.

Even creating an artifact, we would need to execute many serial- parallel tasks in order to complete and deliver the final outcome. As to the function of modern artifact, it is always getting more and more complicated, and the divisions of works become more and more professional for some reasons, such as cost efficiency, or oligopoly market. As a result of that, tasks would always be grouped to

achieve the best efficiency by several different players, and the interface among task group would be created accordingly. By following the same principle, an artifact could be grouped in a different way determined by different kind of players. Especially, when an artifact is made by multiple players across countries, which usually result in different kind of grouping principle, and creates different module layout accordingly.

This research attempts to put the transnational building construction industry into a differential sociological impact model by using the modularity observation methodology with task dependence model, and tries to figure out a systematic mechanism of transnational project failure in order to establish a foundation of prediction model.

This thesis is divided into five chapters listed as follow,

Chapter I - Introduction: Research, Background, and Motivation

Introducing the motivation and background of this research, and states the purpose of research. It also defines the subject and scope of research, as well as to compare with past research and set up the orientation of this research.

Chapter II - Sociological Phenomenon and Behavior Tendency

The first part of this research identifies that people from different countries carry different kind of practical conventions due to the differential background and environment in all levels from single person to entire organization giving various inputs into system, and creates corresponding combination of interfaces in projects. The purpose of this Chapter is to make a scientific inquiry about the formation of transnational building construction, and try to figure out the both end of sociological spectrum in order to locate the social tendency for different countries within the spectrum. And then figure out an appropriate social phenomenon to verify the sociological spectrum.

A sociological observation on conflict society and consensus society was engaged to reveal the different organizational behavior among societies. In order to verify such theory of sociological tendency, this research took investigation on legal structure, building regulation, and player liability as instrument to extinguish between collaborative tendency and adversarial tendency.

This chapter demonstrates the idea of sociological tendency spectrum to identify the variation of differential professional behavior tendencies. From the legal environment phenomenon, it clearly shows the both end of spectrum are majorly about the level of adversarial consciousness, and this differential tendency creates out two entirely different construction environments which shall carry out different construction methods respectively.

Chapter III - Mechanism of Modularity with Visualized Model

The second part of this research is to establish a scientific methodology to represent the mechanism of invisible dynamic task operation within entities and between entities, and also find a standard methodology to locate the affective interdependent task between entities which would turn out to be the critical paths among problematic module. By using the methodology, this chapter would like to verify the relationship between social tendency and construction method. And there are two risk taking tendencies were found in this chapter reflect to corresponding social background.

The entities from conflict society is more vulnerable against to uncertainty due to the players are more reluctant to accommodated omitted task by adversarial consciousness. Contrarily, the entities from consensus society are more robust against to uncertainty, and allow the system to be designed in an integration oriented system.

In order to verify the hypothesis above, this research has engaged a general overview on differential phenomenon of construction method tendencies between Japan and United States. The observation would be engaged with four different types of construction methods, precast concrete assembly, construction method at parapet area, expansion joint method at roof area, and multiplayer construction at window area.

This chapter indicated the understanding of the entity behavior, and also explored the mechanism of dynamic task flow among entities. Furthermore, the correlation between social tendencies and construction tendencies has been verified by analyzing on the corresponding task structure matrix. In other words, combine the mechanism of human behavior represented by Task Flow Model and the construction method carried out by Task Structure Matrix would provide us a scientific instrument to depict the abstract correlation between sociological tendency and construction tendency.

From the result of general observation and detail analysis, we could easily found that the consensus society tends to adopt the integrated approach in construction, and conflict society prefers the other way around.

Chapter IV - Application and Verification of Modularity Theory

This chapter started from taking an extended observation on the mechanism of tasks leading to project failure, and also the typical contractual operation currently used in construction industry to avoid such failure. And by following the mechanism of invisible dynamic task network demonstrated in Chapter 3, the purpose of this chapter is majorly to apply the theory and methodology established in previous chapter to actual cases with mechanism of failure and contractual system in order to verify the practicability of theory by comparing the task model of building system design in phases.

The first part of this chapter has demonstrated the mechanism of project failure and also the mitigation strategies to facilitate the success of project. From the verification in the second part of this chapter, we may, therefore, reasonable conclude that interdependence among entities is the main source of risk to every construction project. However, a transnational construction project usually carries the interdependence without proper commitment device or culture convention.

In order to overcome the risk, the first verified mitigation strategy is using modular design approach which helps to reduce the interdependence among components as well as to entities. The second verified mitigation strategy is to use proper commitment device of contract to encourage the construction team absorbing more uncertainty under appropriate supervision. The third verified mitigation strategy is to rearrange the organization structure when the interdependence couldn't be effectively reduced by previous two methods.

Chapter V - Conclusion

This chapter is prepared to summarize the systematic theory of this research, and also prospect for the relevant research shall be engaged in the future to extend and consolidate the result.